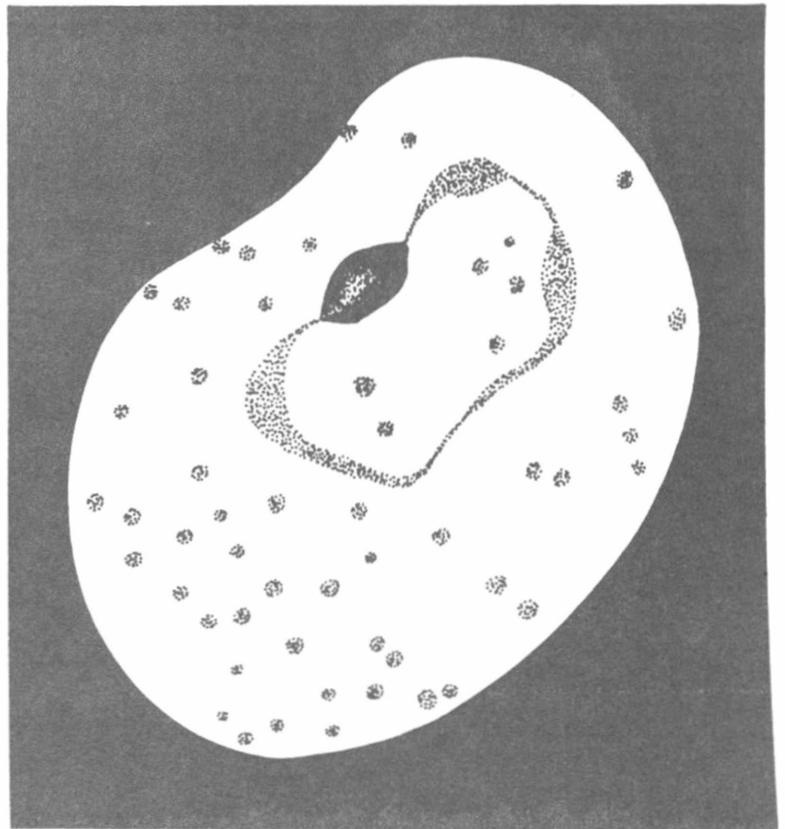




ANNUAL SUMMARY 1991  
Issued April 1994

# MALARIA

## SURVEILLANCE



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service

**CDC**  
CENTERS FOR DISEASE CONTROL  
AND PREVENTION

## Preface

This report summarizes information received from state health departments, medical departments of the Armed Forces, and other sources. It is intended primarily for those responsible for disease control activities. Before quoting this report, contact the original investigator for confirmation and interpretation.

Contributions to the Surveillance Report are most welcome. Please address them to:

Centers for Disease Control and Prevention  
Attn: Epidemiology Branch  
Division of Parasitic Diseases  
National Center for Infectious Diseases  
Atlanta, Georgia 30333  
Telephone: (404) 488-7760

Guidelines for the prevention of malaria in travelers are published in HHS Publication No. (CDC) 93-8280, *Health Information for International Travel 1993*. This booklet also provides information about countries and, where applicable, areas within each country where malaria risk exists. Also listed are areas of the world where chloroquine-resistant strains of *Plasmodium falciparum* are known to exist. The booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

### Suggested Citation

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## Summary

A total of 1,046 cases of malaria with onset of illness in 1991 in the United States and its territories were reported to the Centers for Disease Control (CDC). This compares with 1,098 cases in 1990, a decrease of 5%.

The number of reported cases with onset in the United States occurred in the following groups:

U.S. military personnel	22
U.S. civilians	585
Foreign civilians	439

*Plasmodium vivax* was the parasite identified in 43% of the 1,046 cases, and *P. falciparum* was identified in 39%. *P. malariae* and *P. ovale* were reported in 6% and 2% of the cases, respectively. The species was not determined in the other 9%.

Eight of the 1,046 persons acquired the infection in the United States.

No deaths were attributed to malaria for 1991.

## Terminology

This report uses terminology derived from the recommendations of the World Health Organization (WHO).<sup>1</sup> Definitions of the following terms are included for reference.

### Autochthonous

1. Indigenous—malaria acquired by mosquito transmission in an area where malaria occurs regularly.

2. Introduced—malaria acquired by mosquito transmission from an imported case in an area where malaria does not occur regularly.

### Imported

Malaria acquired outside a specific area (the United States and its territories in this report).

### Induced

Malaria acquired through artificial means; i.e., blood transfusion, common syringes, or malariotherapy.

## Relapsing

Renewed manifestation (of clinical symptoms and/or parasitemia) of malarial infection that is separated from previous manifestations of the same infection by an interval greater than those due to the normal periodicity of the paroxysms.

## Cryptic

An isolated case of malaria ascertained by appropriate epidemiologic investigation not to be associated with secondary cases.

## General Surveillance

This section covers four topics: the incidence of malaria, the *Plasmodium* species involved, the area in which infection was acquired and in which the onset of illness occurred, and the interval between the patient's arrival in the United States and the onset of clinical symptoms.

## Incidence

A total of 1,046 malaria cases with onset of illness in 1991 in the United States were reported to the Division of Parasitic Diseases, National Center for Infectious Diseases, Centers for Disease Control, compared with 1,098 cases in 1990. In 1991, 8 of the 1,046 patients acquired the infection in the United States.

Only 22 cases occurred in U.S. military personnel. Civilians have accounted for most of the cases each year since 1973 (Table 1). The number of malaria cases in U.S. civilians increased from 558 in 1990 to 585 in 1991. (Figure 1). Malaria in foreign civilians decreased from 504 reported cases in 1990 to 439 in 1991.

## Plasmodium Species

The *Plasmodium* species was identified in 949 (91%) of the 1,046 cases. In 1991, *P. vivax* was identified in blood from 43% of the infected persons and *P. falciparum* in blood from 39% (Table 2).

**Table 1. All primary malaria cases\* in civilians and U.S. military personnel with onset of illness in the United States, 1966-1991**

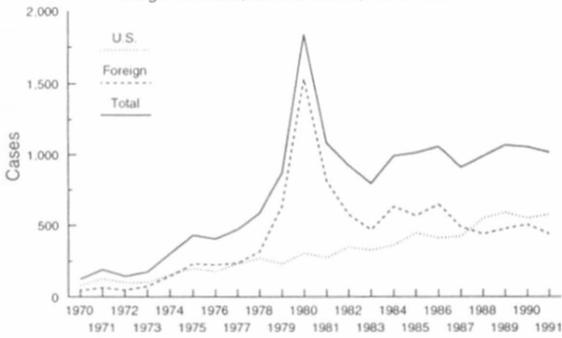
Year	U.S. Military Personnel	U.S. Civilians	Foreign Civilians	Unknown	Total
1966	621	89	32	22	764
1967	2,699	92	51	15	2,857
1968	2,567	82	49	0	2,698
1969	3,914	90	47	11	4,062
1970	4,096	90	44	17	4,247
1971	2,975	79	69	57	3,180
1972	454	106	54	0	614
1973	41	103	78	0	222
1974	21	158	144	0	323
1975	17	199	232	0	448
1976	5	178	227	5	415
1977	11	233	237	0	481
1978	31	270	315	0	616
1979	11	229	634	3	877
1980	26	303	1,534	1	1,864
1981	21	273	809	0	1,103
1982	8	348	574	0	930
1983	10	325	468	0	803
1984	24	360	632	0	1,016
1985	31	446	568	0	1,045
1986	35	410	646	0	1,091
1987	23	421	488	0	932
1988	33	550	440	0	1,023
1989	35	591	476	0	1,102
1990	36	558	504	0	1,098
1991	22	585	439	0	1,046

\*A "case" is defined as: 1) a person's first attack of malaria in the United States, regardless of whether or not he/she had experienced previous attacks of malaria while outside the country and 2) a positive peripheral blood smear examined in the local or state health department laboratory. A subsequent attack in the same person caused by a different *Plasmodium* species is counted as an additional case. A repeated attack in the same person in this country caused by the same species is not considered an additional case.

**Table 2. Malaria cases by *Plasmodium* species, United States, 1990-1991**

Species	1990		1991	
	Total	Percent	Total	Percent
<i>P. vivax</i>	531	48.4	453	43.3
<i>P. falciparum</i>	428	39.0	410	39.2
<i>P. malariae</i>	50	4.6	62	5.9
<i>P. ovale</i>	20	1.8	24	2.3
Mixed	3	0.3	0	0.0
Undetermined	66	6.0	97	9.2
<b>Total</b>	<b>1,098</b>	<b>100.0</b>	<b>1,046</b>	<b>100.0</b>

Fig. 1. Cases of Malaria in U.S. Civilians and Foreign Civilians, United States, 1970-1991



\*Includes Puerto Rico, the Virgin Islands, and Guam

86.9% of the *P. falciparum* cases and in 38.3% of the *P. vivax* cases (Table 4). Only 11 (1.7%) of the 659 patients became ill 1 year or more after their arrival in the United States.

## Imported Malaria in Military Personnel

Twenty-two cases of imported malaria in U.S. military personnel were reported for 1991. The Army accounted for 6 cases, the Navy for 3, the Air Force for 4, the Marine Corps for 6 cases, and the Branch of Service was not recorded for 3 cases.

## Area of Acquisition and of Onset of Illness

The area in which each of the 1,046 patients acquired the infection is listed in Table 3. The geographic distribution of malaria cases within the United States is shown in Figure 2 by the state in which the patient first developed clinical symptoms of malaria.

## Imported Malaria in Civilians

Of the 1,016 imported malaria cases in civilians, 577 (57%) were in U.S. citizens, whereas 439 (43%) were in citizens of other countries (Table 5).

## Interval Between Arrival and Illness

The interval between the date of arrival in the United States and the date of onset of illness was known for 659 of the patients for which the infecting *Plasmodium* species was also identified. Clinical malaria developed within 1 month after the patient's arrival in

## U.S. Civilians

Of the 577 cases in U.S. civilians, 308 (53%) were acquired in Africa, and 128 (22%) were acquired in Asia (Table 5).

The largest percentage of U.S. civilians had traveled to visit friends and relatives (Table 6).

Fig. 2 Malaria cases with onset in the United States, by state, 1991



**Table 3. Malaria cases by distribution of *Plasmodium* species and area of acquisition, United States, 1991**

Area of Acquisition	<i>Vivax</i>	<i>Falciparum</i>	<i>Malariae</i>	<i>Ovale</i>	Mixed	Unknown	Total
AFRICA	18	342	31	22	0	53	466
Africa, Unspecified*	0	18	0	5	0	4	27
Africa, East*	0	4	1	0	0	1	6
Africa, West*	0	24	3	0	0	3	30
Africa, Central*	0	2	0	0	0	0	2
Africa, South*	0	2	0	0	0	0	2
Angola	0	1	0	0	0	0	1
Benin	0	2	0	1	0	1	4
Burkina Faso	0	1	0	0	0	0	1
Burundi	0	1	0	0	0	0	1
Cameroon	0	5	0	0	0	2	7
Central African Rep.	1	1	1	0	0	0	3
Chad	0	3	0	0	0	1	4
Congo	0	0	0	1	0	0	1
Egypt	0	0	0	0	0	0	1
Ethiopia	1	1	0	0	0	0	2
Gabon	0	1	0	2	0	0	3
Gambia	0	2	0	0	0	1	3
Ghana	3	53	4	5	0	6	71
Guinea	0	4	0	0	0	1	5
Ivory Coast	0	6	5	0	0	0	11
Kenya	4	27	2	0	0	3	36
Liberia	2	11	3	0	0	3	19
Madagascar	0	2	0	0	0	0	2
Malawi	0	1	0	0	0	0	1
Mali	0	2	1	1	0	2	6
Niger	0	1	0	0	0	0	1
Nigeria	6	134	4	4	0	16	164
Senegal	0	1	0	0	0	1	2
Sierra Leone	0	12	7	1	0	0	20
South Africa	0	0	0	1	0	0	1
Sudan	0	0	0	0	0	2	2
Tanzania	0	1	0	0	0	0	1
Togo	0	5	0	0	0	2	7
Uganda	0	7	0	0	0	2	9
Zaire	1	7	0	1	0	0	9
Zambia	0	1	0	0	0	0	1
ASIA	241	37	20	1	0	22	321
Asia, Unspec.*	12	0	0	0	0	0	12
Asia, Southeast*	5	0	0	0	0	1	6
Afghanistan	1	2	0	0	0	0	3
Bangladesh	2	0	0	0	0	0	2
Cambodia	1	0	0	0	0	0	1
China	0	0	1	0	0	0	1
India	163	25	16	1	0	16	221
Indonesia	14	2	0	0	0	0	16
Iraq	2	0	0	0	0	0	2
Malaysia	1	0	0	0	0	1	2
Mozambique	0	1	0	0	0	0	1
Pakistan	13	2	0	0	0	1	16
Philippines	13	2	1	0	0	1	17
Thailand	4	2	0	0	0	0	6
Turkey	1	0	0	0	0	0	1
Vietnam	8	2	2	0	0	2	14
CENTRAL AMERICA AND CARIBBEAN	86	13	5	0	0	5	109
Central Am. Unspec.*	18	1	1	0	0	1	21
Belize	4	0	0	0	0	0	4
Costa Rica	2	0	0	0	0	0	2
El Salvador	9	0	1	0	0	0	10
Guatemala	15	1	2	0	0	1	19
Haiti	1	10	0	0	0	1	12
Honduras	33	1	1	0	0	2	37
Nicaragua	3	0	0	0	0	0	3
NORTH AMERICA	52	0	2	0	0	2	56
Mexico	46	0	1	0	0	1	48
United States	6	0	1	0	0	1	8
SOUTH AMERICA	22	5	2	0	0	4	33
South Am. Unspec.*	1	0	0	0	0	1	2
Brazil	3	1	2	0	0	1	7
Colombia	3	1	0	0	0	0	4
Ecuador	4	0	0	0	0	0	4
Guyana	1	3	0	0	0	1	5
Peru	2	0	0	0	0	0	2
Venezuela	8	0	0	0	0	1	9
OCEANIA	30	7	1	0	0	8	46
Oceania, Unspec.*	2	0	0	0	0	0	2
Papua New Guinea	20	7	1	0	0	6	34
Solomon Islands	7	0	0	0	0	2	9
Vanuatu	1	0	0	0	0	0	1
UNKNOWN	3	6	1	1	0	3	14
<b>Total</b>	<b>453</b>	<b>410</b>	<b>62</b>	<b>24</b>	<b>0</b>	<b>97</b>	<b>1,046</b>

\*Country unspecified.

## Foreign Civilians

Of the 439 cases in foreign civilians, 183 (42%) were acquired in Asia and 155 (35%) in Africa.

## Malaria Acquired in the United States

### Congenital Malaria

Case 1—In September 1991, a 2-month-old girl born in California had fever episodes and anemia. The laboratory identified *P. vivax* parasites in a blood smear. The infant was treated with chloroquine and had an uneventful recovery. The mother had visited her native India one year earlier. She had had undiagnosed febrile episodes during the delivery. Following the diagnosis of malaria in her child, laboratory examination of her blood smear revealed the presence of *P. vi-*

*vax* parasites. She was treated with chloroquine and primaquine.

(Reported by R. R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

Case 2—A 4-week-old girl was admitted to a hospital in California in April 1991 with a history of fever episodes. Examination of the blood smears revealed the presence of *P. vivax* parasites. She was treated with chloroquine and had an uneventful recovery. The mother had visited her native Honduras in October 1990 and had been treated there for malaria. Blood smear examination of the mother failed to identify malaria parasites.

(Reported by R. R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

Case 3—A 28-day-old boy in California had several fever episodes in May 1991. Following admission to the hospital, exami-

**Table 4. Imported malaria cases by interval between date of entry and onset of illness and by *Plasmodium* species, United States, 1991**

Interval (in months)	<i>Vivax</i> (%)	<i>Falciparum</i> (%)	<i>Malariae</i> (%)	<i>Ovale</i> (%)	Total (%)
<1	91 (38.3)	243 (86.9)	18 (43.9)	4 (26.7)	356 (54.0)
1-2	84 (26.2)	28 (9.9)	5 (12.2)	1 (6.7)	118 (17.9)
3-5	64 (19.4)	8 (2.8)	10 (24.4)	5 (33.3)	87 (13.2)
6-12	75 (23.4)	2 (0.7)	6 (14.6)	1 (26.7)	87 (13.2)
12	7 (2.2)	1 (0.4)	2 (4.9)	1 (6.7)	11 (1.7)
<b>Total</b>	<b>321 (100.0)</b>	<b>282 (100.0)</b>	<b>41 (100.0)</b>	<b>15 (100.0)</b>	<b>659 (100.0)</b>

**Table 5. Imported malaria cases in civilians, by area of acquisition, United States, 1991**

Area of Acquisition	United States		Foreign		Total	
	Cases	Percent	Cases	Percent	Cases	Percent
Africa	308	53.3	155	35.3	463	45.6
Asia	124	22.2	183	41.7	311	30.6
Central America	46	7.9	44	10.0	90	8.9
Caribbean	9	1.6	2	0.5	11	1.1
Mexico	18	3.1	30	6.8	48	4.7
South America	21	3.6	12	2.7	33	3.2
Oceania	42	7.3	4	0.9	46	4.5
Unknown	5	0.9	9	23.1	14	1.4
<b>Total</b>	<b>577</b>	<b>100.0</b>	<b>439</b>	<b>100.0</b>	<b>1,016</b>	<b>100.0</b>

nation of the blood smears identified *P. vivax* parasites. He was treated with chloroquine and recovered uneventfully. His mother had visited her native Belize for 1 year from April 1990. She had febrile episodes during the delivery. *P. vivax* parasites were identified in her blood smears. She was treated with chloroquine and primaquine.

(Reported by R. R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

Case 4—A 4-month-old girl in California was admitted to the hospital with a history of failure to thrive. Blood smear examination revealed the presence of *P. malariae* parasites. The infant was successfully treated with chloroquine. The mother was born in Laos and emigrated to the United States in 1979. No malaria parasites were detected in her blood smears.

(Reported by R. R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

Case 5—A 6-week-old girl was admitted to a hospital in California in February 1991 with a 3-day history of vomiting and fevers. Examination of her blood smears identified *P. vivax* parasites. She was treated with chloroquine and had an uneventful recovery. The mother had emigrated to the United States from Guatemala in February 1990. Four years before emigrating she had reportedly been treated for malaria. Blood smear examination did not identify malaria parasites. She was treated with chloroquine and primaquine.

(Reported by T. V. Hulbert, M.D., Los Angeles; L. Mascola, M.D., Los Angeles County Health Department; R. R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

### Cryptic Malaria

Case 1—A 54-year-old male resident of Yuba City, California, experienced

chills and fever starting on March 15, 1991. Examination of his blood smears revealed the presence of *P. vivax* parasites. He was treated with chloroquine and primaquine and recovered uneventfully.

The patient had emigrated from India to the United States in 1966 and had not traveled abroad since that time. He denied a history of blood transfusions and drug abuse. No other cases of malaria were identified in the area.

(Reported by R. R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

Case 2—On September 9, 1991, parasites of undetermined species were identified during a routine blood smear examination of a 29-year-old female resident of Sicklerville, New Jersey, who had a 4-day history of fever, chills, and headaches. Sicklerville is located in the southern part of New Jersey. The parasites were initially suspected to be *Babesia* and the patient was treated with quinine and clindamycin. Subsequently, the parasites were identified as *P. vivax* and primaquine was added. The patient had an uneventful recovery.

The patient had never traveled outside the United States, had never received a blood transfusion, and denied use of intravenous drugs or other exposure to needles, injections, or blood products. Travel within New Jersey during the summer of 1991 had been

**Table 6. Imported malaria cases in U.S. civilians, by category, United States, 1991**

Category	Cases	Percent
Tourist	55	9.5
Business representative	63	10.9
Government employee	3	0.5
Missionary	59	10.2
Peace Corps	14	2.3
Seaman/aircrew	4	0.7
Teacher/student	36	6.2
Visiting friends/relatives	192	33.3
Other	37	6.4
Unknown	114	19.8
<b>Total</b>	<b>577</b>	<b>100.0</b>

limited to a 1-day trip to Ocean City (south of Atlantic City) and a 2-day trip to Hammonton in south central New Jersey. She had spent most summer evenings on her back porch.

The patient lives in a single-story apartment complex situated next to a small wooded area and a pond. Recent developments in this area have produced enclaves of single-family housing and high-density apartment buildings interspersed among large active farms that employ migrant farm labor.

Anopheline counts for 1991 in the county were generally above average, attributed to a very mild winter and an unusually hot spring and summer. Migrant workers from Mexico, Central America, and Puerto Rico lived within a mile from the patient. No cases of malaria had been reported from the migrant population.

No other cases of unexplained malaria occurring near the patient have been identified.

Case 3—On September 23, 1991, *P. vivax* parasites were identified on a bone marrow biopsy from an 8-year-old boy residing in Manalapan, New Jersey. Manalapan is located in Monmouth county northeast of Trenton, N.J. On September 15 the child had his first fever; the week before he complained only of headaches. On September 16 he was given amoxicillin for otitis, and 2 days later he was switched to cefaclor for persistent fevers. On September 20 he was hospitalized for thrombocytopenia, leukopenia, and anemia with a fever of 104.5<sup>0</sup> F. A bone marrow biopsy was performed to exclude the diagnosis of leukemia. He was treated with chloroquine and primaquine and recovered uneventfully.

The child has no history of foreign travel. Local travel consisted of a family trip by car to Sarasota and Disney World in Florida from July 3 through 18, 1991. From the last week in July through the third week of August he attended a day camp in a wooded area near Manalapan. He played in his yard and at the local soccer field during the summer months. Travel within New Jersey was limited to areas northeast of Trenton. The patient had no history of exposure to blood products (including transfusions and im-

mune globulin) or possible relevant injections.

The child's home is in a well-groomed neighborhood located near a brook and a storm drain that occasionally collect water. There are several small farms in the area that do not employ farm labor.

Entomologic data for Manalapan for 1991 indicated that light traps had caught only 19 *Anopheles*, 3 of which were *An. quadrimaculatus*.

No other cases of unexplained *P. vivax* malaria have been identified in the area.

(Reported by Kenneth Spitalny, M.D., John Brook, M.D., and Carol A. Genese, M.B.A., C.I.C., New Jersey State Department of Health, Trenton, New Jersey, Julianne Wilkin, D.O., University of Medicine and Dentistry of New Jersey, Stratford, New Jersey, and Wondwessen Bekele, M.D., Newark Beth Israel Hospital, Newark, New Jersey.

**Comment:** Malaria has been eradicated in the United States since the late 1940s or early 1950s, and the last case of locally acquired malaria was reported from New Jersey in 1948. While the majority of reported malaria cases in recent years have occurred in persons who have traveled to or from malaria-endemic areas, they represent a potential source of gametocytes. Such persons, in combination with competent *Anopheline* vectors present throughout much of the country, complete the requirements for malaria transmission. In the past 7 years, local transmission has been suspected in Florida and has occurred repeatedly in southern California. In each instance, migrant workers were suspected as the probable source of *Plasmodium* infection in local *Anopheles* mosquitoes.

Case 2 in New Jersey is likely to be associated with migrant workers from Mexico or Central America. Although no cases of malaria were found among this group, the close proximity of the patient to such migrant workers suggests this as a plausible scenario.

The source of case 3 is more difficult to explain. There was no link between the two patients; neither had traveled to the other's part of New Jersey. While migrant workers may have been involved in the first case, apparently few work in the Manalapan area.

# Malaria Deaths

No deaths due to malaria were reported in 1991.

## Microscopic Diagnosis of Malaria

Early diagnosis of malaria requires that physicians include malaria in the differential diagnosis and take a comprehensive travel history from every patient with a fever of unknown origin. Once malaria is suspected, a Giemsa-stained smear of peripheral blood should be examined for parasites. Since the accuracy of diagnosis depends on the quality of the blood film, the following guide is offered for the proper preparation of thick and thin blood smears.

1. Manufacturers' "precleaned" slides are not considered clean enough for use in malaria diagnosis. Before using them, wash the slides in mild detergent, rinse them thoroughly in warm running water and then in distilled water, and dip them in ethyl alcohol (90%-95%). Then, wipe the slides dry with a lintless cloth or tissue for immediate use, or store them in 95% alcohol until needed.

2. Clean the patient's finger with alcohol and wipe the finger dry with a clean cloth or gauze.

3. Puncture the finger with the blood lancet and allow a large globule of blood to form.

4. Place the cleaned surface of the slide against the drop of blood and, with a quick

circular motion, make a film the size of a dime in one-third of the area of the slide. Ordinary newsprint should be barely legible through such a wet drop (Figure 3). (Excessive mixing or stirring with a second slide leads to distortion of blood cells and parasites.)

5. Wipe the finger dry and gently squeeze a *small* drop of blood from the puncture. Place the drop at the middle of the same slide (Figure 4).

6. Apply a clean "spreader" slide to the edge of the small drop at a 45° angle and allow the blood to extend about two thirds of the distance to the back of the slide. Then, keeping even contact, push the spreader forward along the slide. This will produce an even layer of red blood cells with a "feathering" at the lower edge (Figure 5).

7. While the thick blood film dries (minimum of 6 hours at room temperature), keep the slide flat and protected from dust and insects.

8. Label the slide in the upper part of the thin film with the date and the name or initials of the patient, as illustrated (Figure 5).

Note: For rapid diagnosis, make the thick and thin films on separate slides. Air dry the thin film, fix it with methyl alcohol, and stain it immediately. If no parasites are found on the thin film, wait until the thick film is dry and examine it for organisms not detected on the thin preparation.

Fig. 3

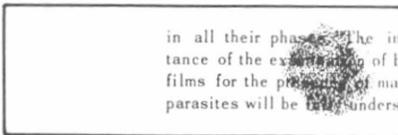


Fig. 4

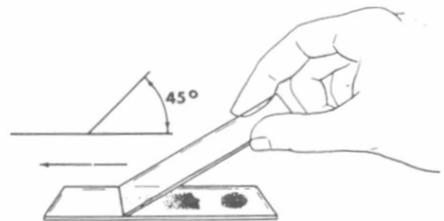
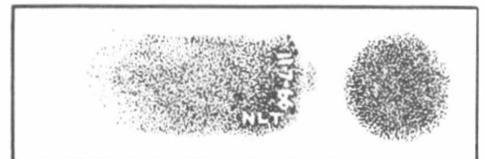


Fig. 5



## Acknowledgment

The annual Centers for Disease Control and Prevention Malaria Surveillance Report is based on information provided in individual case reports. The excellent support given to malaria surveillance by state and local health departments and personnel of the preventive medicine services of the U.S. Army, Navy, and Air Force is greatly appreciated.

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# State and Territorial Epidemiologists

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